

# Flood Protection with Modern Process-Control Technology and IT-Based Automation

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The polder Söllingen/Greffern was built for flood protection on the upper Rhine below Iffezheim. In order to control, monitor and document its operation with a minimum of personnel, the Greffern control centre uses the HydroDat® V8 process-control system from HST Hydro-Systemtechnik. All external constructions are connected to the control system via TeleMatic remote-control stations.

Due to numerous adjustments in the course of the river and the construction of barrage weirs with locks, the number of freely floodable areas along the upper Rhine has declined significantly since 1817. Since these measures have greatly increased the risk of flooding below the modified stretch of river at Iffezheim, the state of Baden-Württemberg has created

13 flood-control areas as part of its "Integrated Rhine Program". The polder Söllingen/Greffern located in the south of the Rastatt district forms part of this far-reaching flood-protection project. The retaining area, which covers more than 580 hectares, is divided into four successive sub-polders and an outflow zone. During flooding of the river, the water is

channelled into the polders from four different points on the Rhine. The retaining capacity of the polders is 12 million m<sup>3</sup> at a maximum damming height of 2.5 metres above terrain. The discharge conditions between the various sub-polders are controlled by large outlet constructions. Three pumping stations pump the water arriving from the inner side into the polders, there-

When the river floods, water is channelled into the polders from four surge constructions at different points on the Rhine. The polders have a retaining volume of 12 million m<sup>3</sup> at a maximum damming height of 2.5 metres above terrain.





Driving machines for the three shields on the surge construction in sub-polder 2.

by preventing flooding of the hinterland. The ground water is kept stable by a number of wells.

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#### Extensive Range of Requirements

In order to control and monitor the machinery and equipment of the Söllingen/Greffern polder as efficiently as possible, the state government in Karlsruhe decided to install an overriding process-control system. The solution adopted had to fulfil the following requirements:

- automatic collection, transmission and processing of machine and equipment data
- direct control of surge and outlet facilities
- maximum automation in the operation of the sub-polders by means of regulating devices
- precise measurement of outflows through the various constructions
- alerting of operating personnel in case of problems
- transmission of certain signals and measurements to the flood-control centre in Karlsruhe
- high fail-safe protection for central computer components by means of redundancy concept
- automatic documentation of operating process.



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After assessing all the quotations submitted, the authorities responsible decided in favour of the process-control system HydroDat® V8 from HST based in Meschede in the Sauerland region of Germany. The HydroDat® V8 system permits efficient and economical collection, visualisation, processing, analysis, documentation and filing of all process data, thereby fulfilling the requirements for control and operation of the centralised and decentralised flood-control facilities.

#### Clear Visualisation of all Processes

In the Greffern control centre, a two-computer process-control system was installed with redundant operating stands. The two

operating stands each consist of three TFT displays for overview and individual-plant images as well as graphics and reports. An office computer carries out general analysis of data, controls the video cameras on some of the external plant and displays the images they produce. The graphic process images displayed to scale on the various screens help to visualise the complex technical processes. Clarity is further increased by adding certain multimedia elements. A graphic process-image editor and extensive libraries of industrial and application symbols assist in planning the visualisation, which can be tested in simulation mode before being released.

Via a menu in the visualisation system, all the data contained in a process image can also be displayed in tabular form or as dot, line, bar or surface diagrams. For comparison purposes, a freely adjustable time-lapse function also makes it possible to display historic data saved using the Delta-Event process.

The data usually archived by conventional process-control systems are averages (e.g. over 15 minutes or one day) and consequently lose much of their detail information in the course of time. The Data-Event process used by HydroDat® only files a value (with time stamp) in the database when it has changed within a certain fixed frame (e.g. two percent). In this way, the quantity of information is effectively reduced and important data remain available for many years.

#### Automatic Alarm Concept

An important part of the HydroDat® V8 system is the graphic analysis of saved data, which, in the case of the Söllingen/Greffern polder, also contributes to better automatic control of small-scale ecological flooding. The user can select the analysis period at will and have the data displayed in the form of bar charts, dots, surfaces or hydrographic curves in various colours. All analyses are then saved for the individual user. Freely configured report formats such as daily, monthly, yearly, maintenance or problem-signal reports are also available, which can then be forwarded to the departments concerned. In this way, it is possible to document events clearly and understandably in order to take the action required.

Since the Greffern control centre is continuously occupied only during large-scale ecological flooding and retentions, the remote-alarm system offered by the HydroDat® V8 process-control system is particularly important. It serves to notify standby personnel automatically in case of problems or malfunctions. An SMS message is sent to the mobile telephone of the employee on standby, who must then acknowledge it immediately. If the first employee cannot be contacted, the system alerts a number of other persons by means of an automatic dialling and announcement system. In addition to a mobile telephone, the standby service also has a notebook computer through which he can contact the process-control system for further details. This ensures that problems can be detected and solved quickly before more serious irregularities occur.

Over 100 different constructions and facilities are involved in the operation of the

Söllingen/Greffern polder system, most of which are controlled and monitored at the control centre at Greffern. For this purpose, a 14-km long fibre-optic (LWL) cable was laid along the sides of the individual sub-polders. The HST TeleMatic remote-control stations located in the facilities for recording and processing signals, readings and control commands, are all connected to this cable. To ensure maximum availability, two fibres in the LWL cable were interconnected to form a physical ring with a power switch. In addition to data, speech and video images are also transmitted, so a number of different protocols based on Ethernet TCP/IP are used. Several of the more distant constructions in the inflow area are connected with the control centre via the public telephone system, while 18 wells of a ground-water storage system are integrated into the network by the profibus system.

During ecological flooding and retention operations, four devices for controlling top water level and outflow ensure more or less automatic water control in the individual sub-polders. The flooding is controlled by the Rhine outflow which is measured by a reference level and transmitted to the process-control system by FTP protocol via the state network (LVN).

#### Economical Remote-Control Solution

The numerous external constructions of the Söllingen/Greffern polder are connected to the process-control system by the HST TeleMatic remote-control stations. This innovative and efficient automatic control and monitoring system for remote constructions and facilities consists of IEC 61131-3 programmable top-hat-rail computers with Ethernet interfaces, to which a maximum of 64 TeleMatic KL bus terminals can be connected as local E/A extensions depending on application. The operating system used is Windows CE or XP. Since the external stations are linked with the process-control system, and both the control centre and the remote constructions operate with PC technology, the conventional remote-control points can be replaced by software. This is an important factor in cost reduction.

Through the use of open standards, the TeleMatic remote-control stations can be programmed, diagnosed and configured through a remote data-transfer connec-



Monitoring of an outlet construction with a TeleMatic Controller type SMART-400.

tion Internet or Intranet. The remote-control protocol based on IEC 60870-5-104 also contributes to the high safety of investment. The variable equipment of the stations with only the interfaces they actually require, keeps the space requirement to a minimum. The customer was also impressed by the decentralised redundant remote-alarm concept which contacts the mobile telephone of standby personnel when problems occur. This guarantees high availability of the external facilities. Another positive factor is the possibility of decentralised local visualisation. This function is unique among remote-control systems and permits direct operation and observation of external constructions by means of a graphic process image. The same process images are displayed to the operator as in the control centre in Greffern without the necessity for an additional industrial computer.

#### Conclusion

The "Integrated Rhine Program" initiated by the state of Baden-Württemberg is a highly effective project for protecting the upper Rhine region from the effects of flooding and restoring the ecological balance of flood meadows. The HydroDat® V8 process-control system and the TeleMatic remote-control system play an important part in the safe and efficient operation of the polder by automatically controlling and documenting all the water flowing out of and back into the Rhine.